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(54) MACHINE FOR MULTICOLOUR PRINTING OF HOLLOW CYLINDRICAL WORKPIECES

(71) I, KURT GOTTLÖB HINTERKOPF, a citizen of the German Federal Republic, of Gutenbergstr. 5, Eisingen (Fils), German Federal Republic, do hereby declare the invention, for which I pray that a patent may be granted to me, and the method by which it is to be performed, to be particularly described in and by the following statement:—

10 The invention relates to a machine for the multicolour printing of hollow cylindrical workpieces.

Known machines for the multicolour printing of hollow cylindrical workpieces include at least one varnishing device, at least one printing device and at least one drying device, between which devices the workpieces can be transported, preferably placed on spindles. In the known machines the printing device is arranged in the next space next to the varnishing device, to which the workpieces are directly supplied, the drying devices being arranged above the varnishing and printing devices. To this end the workpieces to be processed are guided by means of a band conveyor in the form of an open link chain through the varnishing device, upwardly to the drying device, then again downwardly to the printing device and then again upwardly to the drying device, from where they reach the removal station. In this construction it is disadvantageous that the path of travel, which the hollow workpieces must cover, is very long, which means that, on the one hand, the transport device is very expensive and, on the other hand, the time expended for the transport between the individual devices is very considerable. Therefore, a pick-up attachment must be provided in each of these devices, which attachment removes the workpieces from the spindles, takes them to the processing station and again puts them on to a spindle, the number of such workpiece-handling devices

being multiplied, as in certain circumstances a plurality of printing devices must be provided each for a specific colour. Moreover, it has been shown that during transport from and to the individual devices and on manipulation of the workpieces, there are relatively many rejects.

An object of the present invention is to provide a machine for the multicolour printing of hollow cylindrical workpieces, in which the lines of transport between the individual devices are considerably reduced and in which the workpieces to be processed can remain during processing thereof on the transport spindles.

According to the invention, I provide a machine for multicolour printing of hollow cylindrical workpieces, comprising a rotary table adapted to turn continuously or in steps and which has a plurality of peripherally-spaced spindles for carrying workpieces, a plurality of stations arranged spaced around the periphery of the rotary table and including a supply station for workpieces succeeded in the table-turning direction firstly by a varnishing station and then by several printing stations having flexographic printing mechanisms, drying stations each overlapping a plurality of consecutive spindles and located one intermediate the varnishing station and the printing station immediately subsequent to the latter, one intermediate each two adjacent printing stations, and one preceding a removal station for the treated workpieces.

The workpieces to be processed are thus directed past the processing stations arranged in direct succession to one another, so that not only are the transport paths between the individual stations reduced to a minimum, but also the losses of time expended in removal of the workpieces and replacement thereof on the spindles before or after processing are avoided. The arrangement of the drying stations is

especially advantageous as the printing effected with one colour is already dried before the printing with another colour.

As several workpieces are exposed 5 simultaneously and for a sufficient period of time to the drying effects of the drying stations on passage between the other stations, the efficiency of drying is increased and there is a saving in time. The heating 10 stations may have hot-air discharge orifices, infra-red radiators, or IST-driers, whereby an extremely quick and intensive and effective drying is achieved.

The flexible printing mechanisms, the use 15 of which is indeed known *per se* in other fields, bring considerable unexpected advantages in the case of the machine according to the invention. In this case it is essential that the flexible printing 20 mechanism uses on transfer of the printing image printing inks which dry quickly through evaporation of solvents under the influence of the drying at said drying stations. This is consequently especially 25 essential as the workpieces to be printed are generally of plastics material or metal, with which in contrast to paper the liquid is not even partly sucked off or evaporated. Moreover, the flexible printing mechanism 30 uses, in contrast to what is known, a single stereotype roller printing the workpiece, to which roller colour is supplied by an applicatory roller which for its part rolls on a roller dipping into a colour container. 35 The transport with the spindles may be effected in different ways, for example by providing the spindles around the entire periphery of the rotary table and putting the workpieces on the spindles and removing 40 them therefrom at supply and removal stations. The advantage consists in that the turret-like rotary table can turn independently of supply and removal devices and is therefore to some extent independent 45 of breakdowns of these devices, it being possible to interpose storage places or the like. It is, however, also possible to have the spindles with the workpieces come to bear on the rotary table at the supply station 50 and move away therefrom at the removal station.

The advantage in this case resides in that the spindles can be arranged on an endless chain and no handling devices are necessary 55 to put workpieces which are to be treated from a transport device on to the spindles of the rotary table at the supply station, or to remove workpieces which have been treated at the removal station.

60 In order that the workpieces can be appropriately turned at the various stations, it is advantageous if the spindles, which can preferably be positively coupled with the workpiece, can be coupled with a central 65 wheel arranged co-axially with the rotary

table but nevertheless turnable independently of the latter. For adaptation to different diameters of the workpieces, the turning of the central wheel and stereotype roller is determined as a function of the workpiece 70 diameter, so that the peripheral speed of the stereotype roller and workpiece is always the same.

Further details and developments of the invention are to be gathered from the 75 following description in which the invention is described in more detail and explained with reference to the embodiment illustrated in the drawing. There are shown:

In Fig. 1 a diagrammatic representation 80 of a machine according to the invention in plan view, and in Fig. 2 a detail on a larger scale of the embodiment according to Fig. 1.

The embodiment diagrammatically shown 85 in the drawing of the machine 11 according to the invention for multicolour printing of hollow cylindrical workpieces 12, such for example as boxes, tubes and the like, which may be closed at one end or open at both 90 ends, includes a revolving or rotary table 13 which is rotated continuously or step by step about a central shaft 14 by means of a drive (not shown). The revolving or rotary table 13 has bearings or cut-outs 16 arranged 95 evenly spaced at its periphery, workpiece carriers in the form of spindles 17 being pivoted in the bearings 16 in a suitable manner. One spindle 17 is provided in each bearing 16. 100

At a first position 18 of the periphery 100 of the rotary table there is arranged a diagrammatically-shown supply station 19 for the workpieces 12 to be treated. At a second position of the rotary table periphery 105 there is, moreover, arranged a varnishing station 22 indicated only by a turnable roller, there being a single cut-out 16 with a spindle 17 between the varnishing station 22 and the supply station 19 in the illus- 110 trated embodiment. Furthermore, there is arranged immediately subsequent to the varnishing device 22 a first intermediate drying station 23 which essentially overlaps three adjacent cut-outs 16. Immediately 115 subsequent to the drying station 23 there is a first printing station 24, then again immediately subsequent to the latter a second intermediate drying station 26, a second printing station 27, then a third, fourth, 120 fifth and sixth intermediate drying station 28, 31, 33 and 36, respectively, alternating with a third, fourth, fifth and sixth printing station 29, 32, 34 and 37, respectively. Immediately subsequent to the last printing 125 station 37 is a final drying station 38 which in this embodiment overlaps five adjacent cut-outs 16. A removal or delivery station 39 is immediately subsequent to the final drying station 38. 130

The processing of the workpieces 12, that is the tubes, boxes and the like forming hollow cylindrical bodies, proceeds in the following way: workpieces to be treated 5 are supplied at the supply station 19 by a conveyor band 41 provided with spindles corresponding with the spindles 17, and are placed each on one spindle 17 on the rotary table 13 by means of a pick-up attachment 10 (not shown). On the rotary table 13 which is rotated step by step or continuously, the workpiece 12 concerned is varnished during the rotation internally and/or externally at the varnishing station 22, while the work- 15 piece rolls for example on a varnishing roll, is then dried at the first intermediate drying station 23, is then printed at the first printing printing station 24 over its entire periphery or only over a part of its periphery by 20 means of a specific colour, is then dried by the second intermediate drying station 26, is then again printed at the second printing station 27, for example with another colour and either at the same peripheral region 25 or another peripheral region with the same motif or another motif of the same characterisation, then again dried etc., until it leaves the last printing station 37 and, after moving past the final drying station 38, is 30 taken to the removal or delivery station 39 at which it is raised from the spindle 17 by means of a second pick-up device (not shown) and is set down on a conveyor band 42 likewise provided with spindles and 35 which takes the workpiece 12, for example to a packing machine or a filling machine or the like. It will be manifest that further stations may be included between the final drying station 38 and the removal station 40 39, for example, a further varnishing station which coats or the like the printed regions. It will also be manifest that more or fewer printing stations may be provided and be 45 in operation on rotation of the rotary table 13, all according to the number of different colours with which the hollow body 12 is to be printed. Storage devices may also be provided between the rotary table and the supply and/or removal stations or station. 50 It is also possible to combine the conveyor bands 41 and 42 and place them at the periphery of the rotary table, so that there is no need for transfer to and from the rotary table.

55 The printing stations 24, 27, 29, 32, 34 and 37 are equipped with flexible printing mechanisms which have a stereotype roller 43 on which the stereotype 44 extends over part only of the roller periphery. This part 60 of the periphery depends on the diametrical relationships of the stereotype roller 43 and the workpieces 12 to be processed. The stereotype roller 43 rolls on an applicatory roller 46 which takes care of transfer of 65 colour on to the stereotype 44. The appli-

catory roller 46 rolls on a roller 47 of greater diameter and which dips over at least part of its periphery into a colour container 48 filled with colour. The appropriate required colour is in the individual colour containers 70 48.

In order that the application of colour from the stereotype roller 43 on to the workpiece is always uniform independent of the diameter in use of the workpiece. 75 the drive (not shown) of the stereotype roller 43 is coupled by way of an adjustable gearing with a central pinion 51 which is disposed below the rotary table 13 and is freely rotatable relative to the latter and 80 its shaft 14. The adjustable gearing (not shown) may be adjusted depending on the diameter of the workpieces 12.

The spindles 17, which have clamping devices 52 for positive rotationally-fast 85 connection with the pertaining workpiece 12, can be connected rotationally-fast with a pinion 54 by way of diagrammatically shown change-shift gearing 53, which pinion 54 meshes with the central pinion 51. 90 The gearing 53 is shifted at least on printing at the individual printing stations, so that by way of the central pinion 51 not only the stereotype roller 43 but also the pertaining spindle 17 is driven. With the 95 adjustable gearing (not shown) for the stereotype roller 43 is it possible to make the peripheral speeds of the stereotype roller 43 and the workpiece 12 the same, which must be the case on printing. 100

The intermediate drying stations 23, 26, 28, 31, 33 and 36 and the final drying station 38 are equipped with quick drying devices with which it is possible to have the 105 solvent used in the printing inks with the flexible printing mechanisms to vapourise quickly, so that the print dries quickly and a further processing can be undertaken. Drying devices may be operated, for example by means of hot air. It is, how- 110 ever, also possible to use infra-red energy bearing light, and IST-drying or other electromagnetic radiation. Such a quick drying device is therefore necessary as the workpieces 12 in general are of plastics 115 material or metal which do not in any way absorb the liquid contained in the ink.

It will be understood that more or a lesser number of spindles and processing stations may be provided at the rotary 120 table than are shown in the present case.

#### WHAT I CLAIM IS:—

1. A machine for multicolour printing of hollow cylindrical workpieces, comprising a rotary table adapted to turn continuously or 125 in steps and which has a plurality of peripherally-spaced spindles for carrying workpieces, a plurality of stations arranged spaced around the periphery of the rotary table and including a supply station for 130

- workpieces succeeded in the table-turning direction firstly by a varnishing station and then by several printing stations having flexographic printing mechanisms, drying stations each overlapping a plurality of consecutive spindles and located one intermediate the varnishing station and the printing station immediately subsequent to the latter, one intermediate each two adjacent printing stations, and one preceding a removal station for the treated workpieces.
2. A machine according to claim 1 or 2, in which the drying at the drying stations is effected by hot-air, infra-red energy-bearing light IST-driers or other electromagnetic radiation.
3. A machine according to claim 1 or 2, in which the flexible printing mechanisms each include for printing the hollow workpieces a stereotype roller which is of greater diameter than the workpieces and bears over part only of the roller periphery the stereotype to which colour is transferred in operation of the machine from an applicatory roller which for its part rolls on a roller dipping into a colour container.
4. A machine according to claim 1, in which the spindles are individually associated each through a clutch coupling with pinions which mesh with a toothed wheel common thereto and movable about a rotary table shaft independently of the rotary table.
5. A machine according to any one of the preceding claims in which the spindles are adapted to be coupled positively with the workpieces.
6. A machine for multicolour printing of hollow cylindrical workpieces, substantially as hereinbefore described with reference to the accompanying drawings.
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